

What is claimed is:

1. A semiconductor device comprising:

a first conducting film formed on a semiconductor substrate;

5 a dielectric deposited on said first conducting film;
and

a second conducting film formed on said dielectric,
wherein said dielectric comprises a polycrystalline
oxide having a plurality of crystal grains and an amorphous
10 oxide present at the boundaries formed between said crystal
grains.

2. A semiconductor device comprising:

a first conducting film formed on a semiconductor
15 substrate;

a dielectric deposited on said first conducting film;
a second conducting film formed on said dielectric,
wherein said dielectric comprises a polycrystalline
oxide with a first crystallization temperature, having a
20 plurality of crystal grains, and an amorphous oxide with a
crystallization temperature higher than the first
crystallization temperature present at boundaries formed
between said crystal grains.

25 3. A semiconductor device comprising:

a first conducting film formed on a semiconductor substrate;

a dielectric deposited on said first conducting film;
and

5 a second conducting film formed on said dielectric,
 wherein said dielectric comprises a polycrystalline
oxide with a first dielectric constant and first
crystallization temperature, having a plurality of crystal
grains, and an amorphous oxide, having a lower dielectric
10 constant than said first dielectric constant and a higher
crystallization temperature than said first
crystallization temperature, present at boundaries formed
between said crystal grains.

15 4. A semiconductor device having a capacitor comprising:
 a first electrode of said capacitor comprising a first
conducting film formed on a semiconductor substrate;

 a dielectric deposited on said first electrode; and

 a second electrode of said capacitor comprising a
20 second conducting film formed on said dielectric,

 wherein the dielectric comprises a polycrystalline
oxide having a plurality of crystal grains and an amorphous
oxide present at boundaries formed between said crystal
grains.

5. A semiconductor device according to claim 1, wherein said polycrystalline oxide comprises niobium pentoxide.

6. A semiconductor device according to claim 1, wherein said
5 polycrystalline oxide comprises niobium pentoxide, and the amorphous oxide comprises tantalum pentoxide.

7. A semiconductor device according to claim 1, wherein the content of the amorphous oxide in said dielectric is from
10 5% to 50%.

8. A semiconductor device according to claim 1, wherein the amorphous oxide comprises at least one oxide selected from among tantalum, silicon, titanium, and tungsten.

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9. A semiconductor device according to claim 1, wherein the film thickness of said dielectric is from 5 nm to 20 nm.

10. A semiconductor device according to claim 4, wherein
20 said first electrode comprises a material selected from ruthenium, platinum, copper, titanium nitride, tantalum nitride and tungsten nitride.

11. A semiconductor device according to claim 4, wherein
25 said first electrode comprises polycrystalline silicon and

a silicon oxide film exists between said first electrode and said dielectric.

12. A manufacturing method of a semiconductor device having
5 a capacitor comprising the steps of:

forming said capacitor on a semiconductor substrate;
depositing a dielectric, comprising a first oxide
with a first crystallization temperature and a second oxide
with a second crystallization temperature higher than said
10 first crystallization temperature; and

heat-treating said dielectric at a temperature equal
to or higher than said first crystallization temperature and
lower than said second crystallization temperature, whereby
said first oxide crystallizes and said second oxide remains
15 amorphous.

13. A manufacturing method of a semiconductor device having
a capacitor comprising the steps of:

forming said capacitor on a semiconductor substrate;
20 depositing a dielectric, comprising a first oxide
with a first crystallization temperature and a second oxide
with a second crystallization temperature higher than said
first crystallization temperature;

heat-treating said dielectric with a temperature equal to or higher than said first crystalline temperature and lower than said second crystalline temperature; and forming a second electrode for said capacitor on said dielectric.

14. A manufacturing method of a semiconductor device according to claim 12, wherein said first oxide is niobium pentoxide and said second oxide is tantalum pentoxide.

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15. A manufacturing method of a semiconductor device according to claim 12, wherein said heat-treatment temperature is from 400°C to 700°C.

15 16. A manufacturing method of a semiconductor device according to claim 12, wherein said amorphous oxide is tantalum pentoxide and said dielectric is formed by a chemical vapor deposition technique using a mixed raw material comprising pentaethoxy tantalum and pentaethoxy niobium.

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17. A manufacturing method of a semiconductor device according to claim 16, wherein said mixed raw material contains pentaethoxy tantalum with a proportion of 5% to 50%.

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18. A manufacturing method of a semiconductor device according to claim 12, wherein said first electrode comprises a material selected from ruthenium, platinum, copper, titanium nitride, tantalum nitride and tungsten nitride.

19. A manufacturing method of a semiconductor device according to claim 12, wherein said first electrode comprises polycrystalline silicon and a silicon oxide film is present between said first electrode and said dielectric.

20. A semiconductor device according to claim 2, wherein said polycrystalline oxide comprises niobium pentoxide.

21. A semiconductor device according to claim 2, wherein said polycrystalline oxide comprises niobium pentoxide, and the amorphous oxide comprises tantalum pentoxide.

22. A semiconductor device according to claim 2, wherein the proportion of the amorphous oxide in said dielectric is from 5% to 50%.

23. A semiconductor device according to claim 2, wherein the amorphous oxide comprises at least one oxide selected from among tantalum, silicon, titanium, and tungsten.

5 24. A semiconductor device according to claim 2, wherein the film thickness of said dielectric is from 5 nm to 20 nm.

25. A semiconductor device according to claim 3, wherein said polycrystalline oxide comprises niobium pentoxide.

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26. A semiconductor device according to claim 3, wherein said polycrystalline oxide comprises niobium pentoxide, and the amorphous oxide comprises tantalum pentoxide.

15 27. A semiconductor device according to claim 3, wherein the proportion of the amorphous oxide in said dielectric is from 5% to 50%.

28. A semiconductor device according to claim 3, wherein the
20 amorphous oxide comprises at least one oxide selected from among tantalum, silicon, titanium, and tungsten.

29. A semiconductor device according to claim 3, wherein the film thickness of said dielectric is from 5 nm to 20 nm.

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30. A semiconductor device according to claim 4, wherein said polycrystalline oxide comprises niobium pentoxide.

31. A semiconductor device according to claim 4, wherein
5 said polycrystalline oxide comprises niobium pentoxide, and the amorphous oxide comprises tantalum pentoxide.

32. A semiconductor device according to claim 4, wherein the proportion of the amorphous oxide in said dielectric is from
10 5% to 50%.

33. A semiconductor device according to claim 4, wherein the amorphous oxide comprises at least one oxide selected from among tantalum, silicon, titanium, and tungsten.

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34. A semiconductor device according to claim 4, wherein the film thickness of said dielectric is from 5 nm to 20 nm.

35. A manufacturing method of a semiconductor device
20 according to claim 13, wherein said first oxide is niobium pentoxide and said second oxide is tantalum pentoxide.

36. A manufacturing method of a semiconductor device according to claim 13, wherein said heat-treatment
25 temperature is from 400°C to 700°C.

37. A manufacturing method of a semiconductor device according to claim 13, wherein said amorphous oxide is tantalum pentoxide and said dielectric is formed by a chemical vapor deposition technique using a mixed raw material comprising pentaethoxy tantalum and pentaethoxy niobium.

38. A manufacturing method of a semiconductor device according to claim 13, wherein said first electrode comprises a material selected from ruthenium, platinum, copper, titanium nitride, tantalum nitride and tungsten nitride.

39. A manufacturing method of a semiconductor device according to claim 13, wherein said first electrode comprises polycrystalline silicon and a silicon oxide film is present between said first electrode and said dielectric.